Low Energy Background Analysis at SNO

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There are two ways that $\beta - \gamma$ decays from the natural U and Th chains can contaminate the solar neutrino signal in the SNO detector. They are:

1. *Photodisintegration of the deuteron*: γ rays with an energy greater than 2.2 MeV can photodisintegrate the deuteron. The resulting neutron from this process is indistinguishable from the neutral-current neutrino signal. Near the bottom of the natural Th and U chains, γ rays that are energetic enough to photodisintegrate the deuteron are emitted in the decay of ^{208}Tl and ^{214}Bi. The light isotropy from these two decays are different due to the difference in the number of particles in the final state. This difference can be exploited to give a measure of the U and Th concentration in the D_2O, from which the photodisintegration background can be determined. Results from this light isotropy study and chemical assays are consistent with each other. Preliminary results show that the photodisintegration background from all sources to be less than 10% of the expected neutral-current signal.

2. *Cherenkov Tail*: A small portion of the high energy tail of the $\beta - \gamma$ decays from internal U and Th contamination in the D_2O is present above the solar neutrino analysis threshold. In addition, mis-reconstruction of $\beta - \gamma$ decay events originating from the H_2O region can contribute to a background signal inside the anlaysis fiducial volume. To understand this source of background, we have deployed low energy background calibration sources to different regions of the detector (D_2O, H_2O, near the acrylic vessel, and near the photomultiplier tube support structure).

   One way to verify our understanding of the detector response to low energy background is by studying the internal backgrounds. During the early period of production running, the ^{222}Rn concentration in the detector was high. If we subtract from this period the low energy background energy spectrum from a low ^{222}Rn period, a ^{222}Rn energy spectrum can be obtained. This is shown in Figure 1. The agreement between this subtracted spectrum and our expectation (source calibrated Monte Carlo) is excellent.

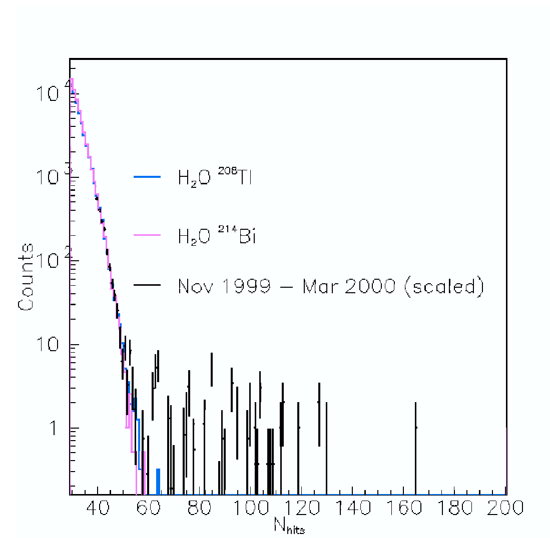

Figure 1: The "high-low" Rn study. At the beginning of production running, the Rn level in the SNO detector was high (Nov. 1999). By subtracting the low energy background from a low ^{222}Rn period (Mar. 2000), the energy spectrum for the low energy background induced by ^{222}Rn can be obtained. Also shown here are the simulated energy spectrum for ^{208}Tl and ^{214}Bi decays in the H_2O region. The counts in the high energy region are the residual neutrino events.